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PERSONNEL CASUALTIES: ESTIMATES DURING CONTINGENCIES

BY

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ABSTRACT

Devising casualty rates for even certain military operations is fraught with uncertainty. To do so for an undefined "enemy" force of unknown numbers, weapons and capability is therefore unwise. Nonetheless, some form of estimate was needed for the recently directed White Paper Staff Check (WPSC). An approach based loosely on DLOR studies of the early 1990's, done in preparation for the Gulf War, was used to arrive at a first order estimate. Thus, in this paper, numbers of personnel casualties are derived, but it is not known whether they are far too low or far too high. They are quite certainly not correct but they are almost certainly reasonable.

RÉSUMÉ

Arriver à des taux de pertes, même pour des opérations militaires connues, est chargé d'incertitude. De le faire pour une force ennemie indeterminée dont le nombre, les armes et la capacité sont inconnus, est d'autant plus téméraire. Néanmoins, une forme quelconque d'estimé était pourtant nécessaire selon la directive récente de la vérification des effectifs du Livre Blanc. Une approche quelque peu semblable à celle qui avait été utilisée lors d'études faites à DRO(T) au début des années 90, en préparation de la guerre du Golfe, a été utilisée pour arriver à un estimé initial. Donc, dans ce rapport, le nombre de pertes sont estimées, mais on ne saurait dire si ces estimés sont beaucoup trop bas ou beaucoup trop haut. Ils sont presque certainement raisonnable mais presque aussi certainement erronnés.

EXECUTIVE SUMMARY

A research project supporting the Land Forces response to the White Paper Staff Check (WPSC) is described. This paper provides an estimate of the number of casualties that might be expected in the chosen WPSC scenario. Basic WPSC guidelines were that Land, Air and Maritime forces were to mount, deploy and sustain appropriate forces for a six month period, to an unspecified location across an ocean (or seven days sailing) away.

The Land Force contribution was determined to be the Op Saber force, which is the generation of a brigade of 6598 troops. During the six month deployment of this "contingency force", two sets of casualty estimates were to be determined. First the force would be involved in one month of medium intensity operations with five months of non-battle activity, and the second involving two months medium intensity operations with four months of non-battle activity. No opposition force was defined, nor were opposing weapon capabilities identified. Nonetheless, part of the WPSC requirement was to provide an estimate of expected attrition. Thus a very generic approach was taken and is described in this report, including the many caveats which had to be highlighted.

Casualties occur during any deployment, and are normally at a rate depending on the level of conflict. Using the standard approaches from the various military publications, as well as a carefully researched American study (Ref 2), estimates for casualties were made. They show that in the first case of one month medium intensity operations, there could be just over 2000 casualties. In the second case of two months medium intensity operations, there could be just over 2800 casualties.

A graph is included which shows the casualty numbers over the six month period.

Due to the acknowledged uncertainty of the WPSC scenarios, it is unwise to use these numbers as anything more that an evaluated but likely unrealistic guess. Usually estimates for casualties can be considered good if, even when many parameters of a conflict are known, the results are within 100 % of actual casualties.

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INTRODUCTION

1. Senior management of the Canadian Forces, in late 1997, instructed that a staff check be done to determine the capability of the forces to respond to a "contingency" operation as called for in the recent White Paper. The resulting coordinated staff effort was referred to as the White Paper Staff Check (WPSC). It was to examine the ability of the CF to take part in a six month long "contingency operation", one or two months of which were to be at a mid-intensity level of armed conflict.

2. An important aspect of the staff check was to determine the levels of personnel and equipment that would be required to mount, deploy and sustain the force, in an unspecified area at least a continent and/or seven sailing days away. The Land Force response was to examine a generic operation called Op Saber which is the generation, deployment and sustainment of a brigade size force. To meet WPSC objectives, Op Saber was to be deployed to an unspecified location across the Atlantic ocean.

ESTIMATING CASUALTIES

3. One part of answering the question " How many people of what sorts are needed"? is the issue of casualty rates, i.e. attrition. Attrition has been studied only incompletely in the Canadian context. Work in the Directorate of Land Operational Research in 1992-3 had resulted from previous intensely researched analysis to support the Gulf War effort. This analysis (Ref 1) had examined personnel attrition only, and resulted in a reasonable estimation approach. Much of that work in turn had been based on Ref 2 which itself was based on earlier American work, on WW 2 experiences and on a database of some 72 conflicts across the spectrum of intensities.

4. The charts derived in these references have been further dissected by others and from them different estimations of attrition for a land force have been suggested. Usually such methods are based on the concept of a Rate of Attrition, an approach best used when planners are unable to give specifics about what risks are involved in a given scenario.

DAILY CASUALTY RATE

5. The Daily Casualty Rate (DCR) is meant to be applied over a long period. It includes days during which there is no fighting and therefore no battle casualties. On such days casualties result only from accidents (incl. training accidents) or illness. The DCR also incorporates those relatively few days when battle action is intense and casualties are high. The low casualty days and the high casualty days are evened out in the concept of the DCR. The rate is usually expressed as a percentage of the force that ceases, day by day, to be capable of taking effective part in the operation.

6. The DCR is generally comprised of various elements, including a separate rate for each of three levels of battle intensity – "low", "medium" and "high". Regrettably, no easy definition of these intensities is available. Within them, a rate is given for "battle casualties", which normally is expected to include people wounded, missing, taken POW or killed. As well there is a component called the "non-battle rate" which accounts for accidents, illnesses and others. In determining an overall DCR, each major fighting unit should have a separate rate applied to it to reflect the risk and observed frequency of casualties for that type unit. For example, most would agree that infantry on the front lines would have a higher daily battle casualty rate than say artillery forces in the same conflict. Further, the DCR should be adjustable to reflect various important aspects of the potential conflict.

7. Ref 2 is one of the most extensively researched studies on casualty estimation ever done. Its author proposes the following minimal set of parameters that must be carefully examined to determine (or modify) the modelling of casualty estimations:

a. personnel strength

b. weapons sophistication / efficiency

c. mobility of force

d. posture (offensive / defensive)

e. terrain influence

f. influence of local weather

g. climate factors

h. surprise factors

i. military effectiveness relative to opponent

8. Each of these is expressed as a multiplier to indicate advantage or disadvantage over the opponent. For example, if one force has 25% more personnel than the other, its multiplier is 1.25. If one or more of these factors is not known or cannot be estimated, it must be set to 1.0 to eliminate bias in the modelling. Doing so implies, for that parameter, that both sides are on a level playing field. Additional knowledge about at least those items, would provide greater accuracy.

LAND FORCE UNITS IN A CONTINGENCY OPERATION

9. For the WPSC, not much is known precisely (except for 6 a above – personnel strength, and that for the Canadian side only) about the contingency operation into which the forces are going. This means that Dupuis' methodology cannot be applied directly. Thus it was decided, from the use of the phrase "two months medium intensity operations" to use attrition rates previously generated in the DLOR work. (Ref 1)

10. A short version of the attrition rates agreed for this study follows in Table 1. Note that the attrition of Maritime and Air elements are accounted for within their own force figures. What follows then (with the exception of one Helicopter (HS) Sqn employed with the Land Forces in Op Saber) is used strictly for the Land Force portion of the WPSC.

TABLE I
BASIC APPLIED DAILY CASUALTY RATES
USED IN THE WHITE PAPER STAFF CHECK

	Low Intensity Battle		Medium Intensity Battle	
	Battle Rate	Non Battle Rate	Battle Rate	Non Battle Rate
Armour	0.15%	0.15%	0.29%	0.15%
Artillery	0.08%	0.08%	0.15%	0.09%
Infantry	0.42%	0.15%	0.83%	0.26%
Engineer	0.03%	0.06%	0.05%	0.06%
HQ & Sigs	0.03%	0.08%	0.05%	0.08%
CSS	0.01%	0.06%	0.06%	0.06%
Med Svcs	0.06%	0.06%	0.06%	0.06%
HS Sqn	0.12%	0.06%	0.24%	0.06%
MPs	0.08%	0.08%	0.08%	0.08%

11. This table gives the daily casualty rates to be applied to the major sub-units making up the Op Saber brigade. To apply these figures for Battle Casualties, we simply multiply the size of the force (e.g. 555 Armoured soldiers) by the DCR of .29% from the Armoured row) to get the total daily casualties of 555 times .0029 for 1.1 as an average daily casualty rate. For a one month figure, multiply that by 30 days (giving 33 casualties). To get both battle and non-battle casualties, add the two rates together, thus 555 times (.0029 + .0015) times 30 days for 58 casualties in a month. Since for Op Saber, replacement troops are to be provided weekly from a Holding Unit, it is reasonable to use the starting strength figure of 555 troops for the entire period.

WPSC EXPECTED CASUALTIES - ONE AND TWO MONTH MEDIUM INTENSITY OPERATIONS

12. Tables II and III use the suggested daily casualty rates from Table I for the LF portion of the contingency force. The tables expand this to derive the monthly and then the composite six month casualties for the two situations of interest. Table II details one month of medium intensity battle with five months of low-intensity non-battle. Table III shows the results for two months of medium intensity battle with four months at low intensity non-battle rates. These tables also show an estimate of the number of replacements needed, which is the difference between the weekly return to battle numbers and the total casualty numbers. This column is simply 47% of the 6 month casualty rate.

TABLE II
CASUALTIES DURING ENTIRE SIX MONTH PERIOD:
ONE MONTH MEDIUM INTENSITY BATTLE
AND FIVE MONTHS LOW INTENSITY NON-BATTLE

TYPE OF FORCE	PERS IN FORCE	Low Intensity		Medium Intensity			WPSC Contingency	
		Non Battle Rate	Cas per Month	Battle Rate	Non Battle Rate	Cas per Month	Casualties In Six months	Repl Needed
Armour	555	0.15%	25	0.29%	0.15%	73	198	93
Artillery	757	0.08%	18	0.15%	0.09%	55	145	68
Infantry	2286	0.15%	103	0.83%	0.26%	748	1262	593
Engineer	591	0.06%	11	0.05%	0.06%	20	73	34
HQ & Sigs	318	0.08%	8	0.05%	0.08%	12	51	24
CSS	1309	0.06%	24	0.06%	0.06%	47	165	78
Med Svcs	316	0.06%	6	0.06%	0.06%	11	40	19
HS Sqn	384	0.12%	13	0.24%	0.08%	37	102	48
MPs	82	0.08%	2	0.08%	0.08%	4	14	6
TOTALS	6598		210			1007	2050	963

TABLE III
CASUALTIES DURING SIX MONTH PERIOD:
TWO MONTHS MEDIUM INTENSITY BATTLE AND
FOUR MONTHS LOW INTENSITY NON-BATTLE

TYPE OF FORCE	PERS IN FORCE	Low Intensity		Medium Intensity			WPSC Contingency	
		Non Battle Rate	Cas per Month	Battle Rate	Non Battle Rate	Cas per Month	Casualties In Six months	Repl Needed
Armour	555	0.15%	25	0.29%	0.15%	73	246	116
Artillery	757	0.08%	18	0.15%	0.09%	55	182	85
Infantry	2286	0.15%	103	0.83%	0.26%	748	1907	896
Engineer	591	0.06%	11	0.05%	0.06%	20	82	38
HQ & Sigs	318	0.08%	8	0.05%	0.08%	12	55	26
CSS	1309	0.06%	24	0.06%	0.06%	47	188	89
Med Svcs	316	0.06%	6	0.06%	0.06%	11	46	21
HS Sqn	384	0.12%	13	0.24%	0.08%	37	126	59
MPs	82	0.08%	2	0.08%	0.08%	4	16	7
TOTALS	6598		210			1007	2848	1337

13. In these tables certain caveats must be acknowledged. Principally – they CAN NOT be considered accurate. (See para 6) Usually casualty rates are thought fairly good if they come within 100% of actual casualties. These figures are based on experience with forces in battle over the long term. They are averages and should not be compared with short term rates for intense battle conditions that would need to be the purview of the medical staffs to plan their surge capability. Nonetheless, the figures given above are likely as good as any which can rapidly be provided, in light of the Staff Check required degree of accuracy, and considering the many unknowns about the situation in which the forces are involved.

14. These data correspond respectively to overall average daily casualty rates of .17% and .24%. In deriving these overall averages, note that:

a. for the 1 month medium intensity situation there are 2050 casualties in 6 months (or 2050/183 = 11.2 cas per day). As an overall rate this is 11.2 persons per day divided by 6598 persons or .0017 per day (.17%). Compare this to other rates in Table II.

b. for the 2 month medium intensity situation there are 2848 cas in 6 months (or 2848/183 = 15.6 cas per day). As an overall rate this is 15.6 persons per day divided by 6598 persons or .0024 per day (.24%). Compare this to other rates in Table III.

15. The week by week accumulation of these casualties, for the situation of 2 months medium intensity operations over a 6 month contingency, is shown in Figure 1 below.

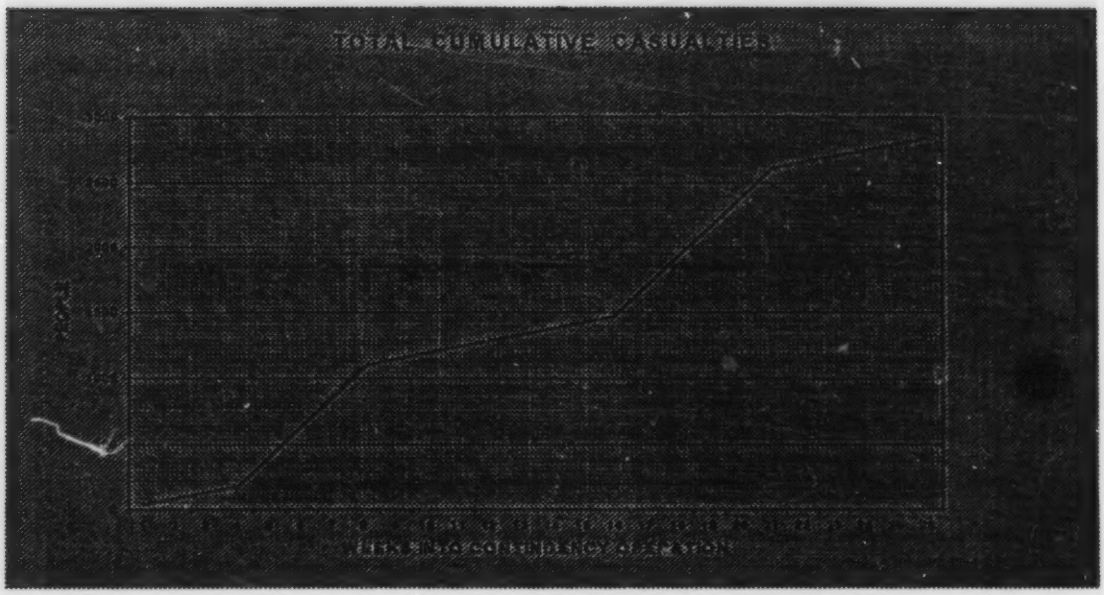

Figure 1: Cumulative Casualties over a Six Month Contingency Operation With Two Months at Medium Intensity Battle

16. In Figure 1, the x axis is the 26 weeks of the six month contingency. The casualty build-up is easily seen where the first month has four weeks at the low intensity non-battle casualty rate. During months 3, 4 and 6 casualties are at that same rate. Steep increases are seen during months 2 and 5. The choice of months 2 and 5 for mid-intensity operations is quite arbitrary, and makes no difference to overall casualties, since replenishments are assumed to occur on a weekly basis.

OTHER CASUALTY ESTIMATIONS

17. An examination was made of Ref 3 in terms of its applicability to the problem of determining casualty rates for the six month contingency operation foreseen for the White Paper Staff Check. Ref 3 was written at the request of J1 Med who wanted *"...to verify the requirements for the Canadian Medical Group (CMG) in terms of the number if beds in the field hospital and the cost of supporting the CMG. The present requirement is felt to be a 200 bed hospital."* Ref 3 begins with an assumption that a Canadian Division of 11500 troops is combating an Iraqi Division of 15000 troops. Following the approach of Dupuy in Ref 2,

a "power ratio" was calculated and applied in determining casualty rates. The calculations for both the power ratio and casualty rates all use the parameters referred to in para 6. Because the situation being modelled was deliberately precise, the author of Ref 3 was able to define very specific values for the necessary parameters.

18. By comparison, the WPSC situation is distinctly different in that an Op Saber brigade of about 6600 vice a division of 11500 is considered. The WPSC does not define any specific opposition force and therefore no opposing capability is specified. No climate / weather is defined, no concern of attack or defence is defined, and therefor no military effectiveness ratio can be assumed. What has been insisted upon is a scenario of two months of medium intensity battle. For these reasons, it would be quite improper to apply the results of Ref 3 to the current situation.

19. Other proposals for attrition rate estimation were examined. Ref 4 details a casualty estimation for Op Saber with the CSG and CMG added on. However, the document uses a daily casualty rate of 1% for all elements of the brigade. The document focuses on types of injuries and the implications for a Replacement Holding Unit. The document is not formally identified in any way but indicates that it is based on Ref 5.

20. Ref 4 was not used in the current study for two reasons:

a. first, it is inappropriate in the WPSC situation to apply the same casualty rate to all elements of a brigade, and

b. second, based on Refs 1 and 2, a daily personnel casualty rate of 1% is too high for the ill-defined WPSC contingency .

21. Attempts to determine casualty rates show high variability as seen in Ref 5, which is ACE Directive 85-8, titled "ACE Medical Support Principles, Policies and Planning Parameters". This is a NATO approved document for general planning of medical facility requirements. In Chapter 5, dealing with casualty rates, this directive discusses, inter alia, a sample One Battalion / One Day Casualty Rate (focussed on a single day of intense combat between capable forces in a continuous front overall scenario) and states:

> "...The sample's battalion 1-day casualty rates are situated between 2.7 and 68.7 % with the 75th percentile at 20.5 %".

22. Because Ref 5 did not consider any medium intensity scenarios, there were no estimates that were appropriate for the WPSC contingency. It did however provide the following table that could be of use in further casualty estimation problems. In this case the rates are meant to apply strictly on a day by day basis, with the understanding that the likelihood is very low that the estimated casualties would occur for even as much as two or more days running.

TABLE IV
ACE PROPOSED CASUALTY RATES FOR LAND FORCES:
ONE DAY TOTAL BATTLE CASUALTIES - INTENSE BATTLE

Command Level	Battle Casualty Rate	Battle Stress Rate	Total Battle Casualty Rate
Battalion	20.5 %	4.1 %	24.6 %
Brigade	6.9 %	1.4 %	8.3 %
Division	3.0 %	0.6 %	3.6 %
Corps	1.4 %	0.3 %	1.7 %
Army	1.0 %	0.2 %	1.2 %

23. The Staff Officers Handbook has a section on Medical Workload Estimating (Ref 6) which also contains a set of generic casualty rates. The rates given are again for a short term. Paragraph B-06.1 states "...the rates are based on degrees of combat activity at each level of command that are unlikely to be sustained for more than a day... ." The rates are expected to apply across the board to the entire command level. Again, as in paras 19 to 21, the rates were not applied to the extended operation of the WPSC.

24. Finally, the Army Lessons Learned Center, in its CD ROM Version 6, (Ref 7) has produced a table for use in Personnel Casualty Planning.. It is based on the Staff Officers Handbook and reproduces the a Table from B-GG-005-004/-017 . The rates are so high (6.75 % per day for a brigade in a moderate intensity situation) that again they must be intended to apply only for a few days at a time. As well therefor, they can not be used in the WPSC situation of moderate intensity battle for two months.

ESTIMATING EQUIPMENT CASUALTIES

25. Ref 2 points out that historically, the battle loss rates of different types of material have been consistently and directly proportional to personnel casualty rates. This means that a quick "back of the envelope" estimate can be made of potential equipment casualties. The loss rates are then simply multipliers of the casualty rates for personnel.

TABLE V
PROPOSED LOSS FACTORS FOR SELECTED EQUIPMENT:
NORMALIZED TO A PERSONNEL CASUALTY RATE OF 1 %

Daily Equipment Loss Factors	
Tanks - Attacking	6
Tanks Defending	3
Artillery	0.25
Trucks	0.50
Small Arms	0.79
Mortar	1.00
Machine Guns	1.25
Radios	1.00

26. For example, the preceding table, based on Figure 66 of Ref 2, indicates that tank losses would be expected to occur at six times the personnel loss rate, in an attacking scenario. In a medium intensity situation, the personnel casualty rate is .29 % for an armoured regiment. Thus tank losses are 6 * .29 % or 1.74 % per day. For such a regiment (with 59 tanks) the tank losses then are about .0174 * 59 or 1 tank per day.

27. As before, these factors and associated rates are intended to be applied over an extended period. If indeed the medium intensity battle went on for a month, which is only ½ the time proposed for the WPSC, then 30 tanks become casualties. In a medium intensity situation, about 30 – 50 % of them can likely be recovered and repaired.

CONCLUSION

28. The WPSC provided an estimate of the ability of the CF to carry out "contingency" operations. For the Land Forces, it was decided to conduct the staff check using the deployment of the Op Saber force (some 6600 troops strong) over a period of six months at different levels of conflict.

29. Estimates are provided of the likely number of casualties that this force would sustain if they were involved in a combination of a low-intensity non-battle situation with medium intensity battle. Specifically if one of the six months is at medium intensity conflict then roughly 2050 casualties are expected overall. As well, if there are two months of medium intensity and four of low intensity non-battle conflict then roughly 2848 casualties are expected. Casualty breakdowns by unit types for these situations are shown in Tables II and III.

30. These casualty estimates are very rough at best. There has been no opportunity, time or guidelines that would allow consideration of such important factors as comparative weapon systems, moral, weather and so on.

31. In addition to the estimates of personnel casualties, a back-of-the-envelope calculation can determine rough estimates for some equipment loss rates. These rates are based on a factor approach and are given in Table V and paras 25 and 26 above.

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7. Personnel Casualty Planning, Lessons Learned Information Warehouse, CD ROM Version 6 -1998, Army Lessons Learned Center, Kingston, Ontario

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